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MEROPLANKTON TAXONOMIC COMPOSITION AND SEASONAL DYNAMICS IN THE SEAPORT KAVKAZ AREA, KERCH STRAIT

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Meroplankton taxonomic composition, distribution of abundance, and seasonal population dynamics were studied in the northern Kerch Strait (the seaport Kavkaz area). For the study, zooplankton material was sampled in different seasons in 2017–2019 in the seaport area and outside it. Zooplankton was sampled totally throughout the water column at depths 5 to 8 m with a large Juday net (opening diameter of 37 cm and mesh size of 120 μm). The samples were fixed in 2–4 % neutral formaldehyde and processed in the laboratory by the conventional method. In total, 32 meroplankton taxa were found. As noted, meroplankton density in the polluted area is not inferior to that of the relatively clean area and provides sufficient reproductive potential there. In the seaport area, barnacle (cirripedian) and mollusc larvae were widespread; outside, barnacle and bivalve larvae were common. The basis of meroplankton pool was formed by species tolerant to water eutrophication and bottom sediment sulfide contamination – larvae of gastropod *Bittium reticulatum*, larvae of bivalves *Abra segmentum*, *Cerastoderma glaucum* (in summer), and *Mytilaster lineatus* (in early autumn), and larvae of barnacle *Amphibalanus improvisus* (in spring). The seasonal dynamics of meroplankton in the study area revealed a summer–autumn increase in abundance which is common for the Black Sea water. The period of the greatest zoobenthos spawning and larvae release into the pelagial lasted April to October. Three density peaks were recorded (April, June, and September), and those were most pronounced in the seaport area in spring and in the open area in early autumn.

Keywords: meroplankton, abundance, seasonal dynamics, Kerch Strait

The Kerch Strait with the adjacent waters of the Sea of Azov–Black Sea basin is the most significant transport artery, a zone of intensive navigation, a spot of port complexes functioning, and a fishing area (Budnichenko & Firulina, 1998 ; Fashchuk & Petrenko, 2008). Location of large terminals and ports, construction of the Tuzla dam, soil dumping, transshipment of liquid and dry cargo, and oil pollution resulted in a disruption of natural sedimentation process, changes in water dynamics, and contamination of bottom sediments; moreover, those became key factors of the alteration in the structure of macrozoobenthos– the basis of the food supply for commercial fish in the strait area (Eremeev et al., 2008 ; Fashchuk et al., 2012). In the northern Kerch Strait (the Chushka Spit), the seaport Kavkaz is located – the second port in terms of cargo turnover in the Sea of Azov–Black Sea basin. Until 2018–2020, passenger and car ferry services to the seaport of Crimea were carried out there, and freight trains were transported. In November 2007, during a severe storm in the Kerch Strait, merchant ships were damaged, about a thousand tons of oil products spilled into the water, and a bulker with sulfur sank near the seaport Kavkaz. Significant water pollution negatively affected the development of psammophilic bottom communities near the western coast of the Chushka Spit (Golovkina & Nabozhenko, 2012). Based on the analysis of current and retrospective distribution of macrozoobenthos in the Kerch Strait, its species structure, and indicators of the development of bottom communities, researchers assessed alterations in bottom communities under the anthropogenic load (Golovkina & Nabozhenko, 2012 ; Samyshev, 2004 ; Fashchuk et al., 2012). However, for the seaport Kavkaz area, with its chronic technogenic pollution, there are no such data.

It is well known that the state of larvae of benthic invertebrates (meroplankton) is one of the key indicators of benthos state, taxonomic composition, and density (Kulikova et al., 2017). At the same time, there was no full-season monitoring of the dynamics of meroplankton structure and its current state in this water area.

The aim of our work is to study meroplankton species composition and abundance distribution for the seaport Kavkaz and to analyze seasonal dynamics of meroplankton abundance.

MATERIAL AND METHODS

The material for the study was zooplankton sampled in different seasons of 2017–2019 in the seaport Kavkaz and outside it (Fig. 1). Zooplankton was sampled totally with a large Juday net (opening diameter of 37 cm; mesh size of 120 μm) at depths 5 to 8 m. The samples were fixed in 2–4 % neutral formaldehyde and processed under laboratory conditions by the conventional method. Mollusc larvae were preliminarily isolated from total zooplankton samples and fixed in 70 % ethanol. A total of 56 plankton samples were analyzed.

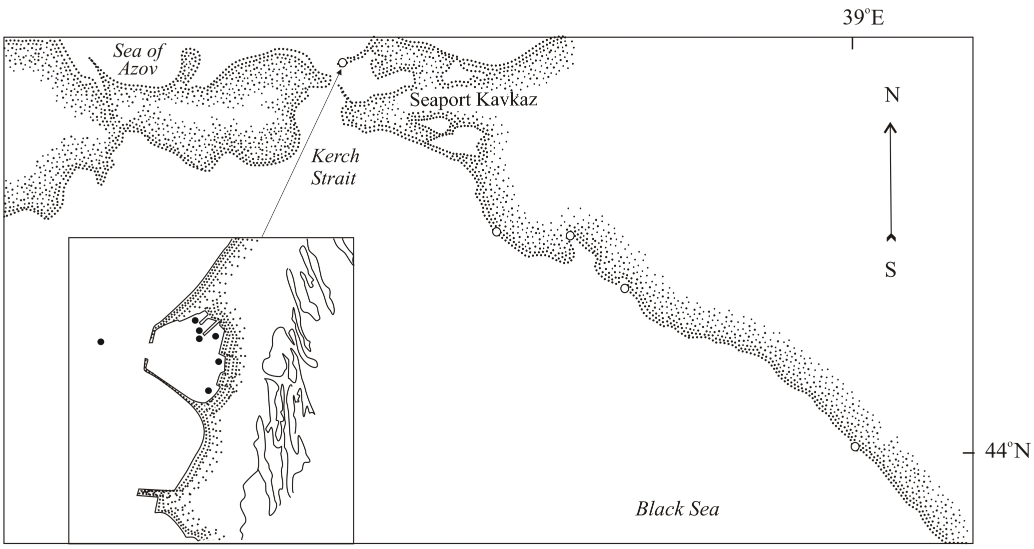

Fig. 1. Map of sampling in the Kerch Strait (the seaport Kavkaz is shown in the inset)

The seaport Kavkaz is located on the Taman Peninsula (the Chushka Spit) in the northern Kerch Strait (see Fig. 1). The Kerch Strait – shallow and relatively narrow one – belongs to the Sea of Azov water area and connects it with the Black Sea. Its length is 43 km, and width varies 4 to 42 km. From the Sea of Azov side, the greatest depths at the strait mouth are ≤ 10.5 m; from the Black Sea side, those are 18 m. As moving towards the mid-strait, the depths gradually decrease; for a large area, those are about 5.5 m. The Kerch Strait currents are mainly caused by wind (Eremeev et al., 2003). Water circulation in the strait depends both on wind and difference in sea levels at two strait sides (the latter one results from surge fluctuations in the level and different freshwater balances of two seas). In the strait, according to the authors' data, the water transfer from the Sea of Azov to the Black Sea is the prevailing one. In the Kerch Strait, water temperature in autumn–winter is usually 2–4 °C higher than in the open sea. In summer, resulting from water exchange between the Sea of Azov and the Black Sea, water temperature in the strait is lower than off the coast. In this area, at the junction of the waters of two seas, there is a frontal zone with large salinity gradients (from 11 ‰ in the north of the strait to 17 ‰ in the south), and this is of key importance for the distribution of bottom communities.

RESULTS

In the community of benthic invertebrate larvae in the seaport Kavkaz, 32 taxa were recorded for the entire study period: Bivalvia, 7; Gastropoda, 6; Polychaeta, 13; Cirripedia, 1; and Decapoda, 5. Out of them, 1 was identified down to a family level; 4, down to a genus level; and 27, down to a species level (Table 1).

Table 1. Meroplankton taxonomic composition in the seaport Kavkaz area (+, the taxon was found; ++, common; and +++, mass)

POLYCHAETA	
Nephtyidae Grube, 1850	
Nephtys hombergii Savigny in Lamarck, 1818	+
Nephtys sp.	+
Polynoidae Kinberg, 1856	
Harmothoe imbricata (Linnaeus, 1767)	+
Nereididae Blainville, 1818	
Alitta succinea (Leuckart, 1847)	+
Hediste diversicolor (O. F. Müller, 1776)	+
Nereididae gen. sp.	+
Spionidae Grube, 1850	
Prionospio cirrifera Wirén, 1883	+
Pygospio elegans Claparède, 1863	+
Microspio mecznikowianus (Claparède, 1869)	+
Polydora cornuta Bosc, 1802	+
Marenzelleria neglecta Sikorski & Bick, 2004	+
Capitellidae Grube, 1862	
Heteromastus filiformis (Claparède, 1864)	+
Capitella capitata (Fabricius, 1780)	+
DECAPODA	
Diogenidae Ortmann, 1892	
Diogenes pugilator (P. Roux, 1829)	+
Upogebiidae Borradaile, 1903	
Upogebia pusilla (Petagna, 1792)	+
Alpheidae Rafinesque, 1815	
Alpheus dentipes Guérin, 1832	+
Palaemonidae Rafinesque, 1815	
Palaemon elegans Rathke, 1836	+
Panopeidae Ortmann, 1893	
Rhithropanopeus harrisii (Gould, 1841)	+

CIRRIPEDIA	
Balaninae Leach, 1817	
Amphibalanus improvisus (Darwin, 1854)	+++
BIVALVIA	
Mytilidae Rafinesque, 1815	
Mytilus galloprovincialis Lamarck, 1819	++
Mytilaster lineatus (Gmelin, 1791)	+++
Myidae Lamarck, 1809	
Mya arenaria Linnaeus, 1758	+
Arcidae Lamarck, 1809	
Anadara kagoshimensis (Tokunaga, 1906)	+
Cardiidae Lamarck, 1809	
Cerastoderma glaucum (Bruguière, 1789)	++
Moerellinae M. Huber, Langleit & Kreipl, 2015	
Moerella sp.	+
Semelidae Stoliczka, 1870 (1825)	
Abra segmentum (Récluz, 1843)	++
GASTROPODA	
Muricidae Rafinesque, 1815	
Rapana venosa (Valenciennes, 1846)	+
Cerithiidae J. Fleming, 1822	
Bittium reticulatum (da Costa, 1778)	+++
Hydrobiidae Stimpson, 1865	
Hydrobia acuta (Draparnaud, 1805)	+
Pyramidellidae Gray, 1840	
Chrysallida sp.	+
Nassariidae Iredale, 1916 (1835)	
Tritia reticulata (Linnaeus, 1758)	+
Rissoidae Gray, 1847	
Rissoa sp.	+

The largest number of taxa (23–26) was registered in June and September, and the smallest one (2–4) was recorded in cold season. Long-term mean quantitative indicators of meroplankton density in the seaport area [(0.77 ± 0.32) thousand ind.·m^{-3}] differed slightly from those at the background station [(0.93 ± 0.31) thousand ind.·m^{-3}] (Table 2).

Table 2. Mean meroplankton abundance in different areas of the seaport Kavkaz in 2017–2019

Area	Abundance, thousand ind.·m^{-3}					
	N_{total}	N_{cir}	N_{biv}	N_{gast}	N_{pol}	N_{dec}
Seaport	0.77 ± 0.32	0.42 ± 0.33	0.15 ± 0.07	0.12 ± 0.1	0.06 ± 0.02	0.02 ± 0.03
Background station	0.93 ± 0.31	0.33 ± 0.2	0.54 ± 0.6	0.013 ± 0.01	0.027 ± 0.02	0.02 ± 0.02

Note: N_{total} denotes total abundance; N_{cir}, N_{biv}, N_{gast}, N_{pol}, and N_{dec} denote abundance of Cirripedia, Bivalvia, Gastropoda, Polychaeta, and Decapoda, respectively.

In the seaport, larvae of cirripedians were abundant (54.5 % of total meroplankton abundance), as well as larvae of molluscs (34.9 %; out of them, 19.4 % were Bivalvia representatives, and 15.5 % were Gastropoda ones). Outside the seaport, larvae of cirripedians (35.4 %) and bivalves (58.0 %) prevailed. Meroplankton ratio in zooplankton composition averaged 30.4 % in the seaport and 19.9 % at the background station. In the study area, surface water layer temperature varied from +6.2 °C in February to +24.7 °C in July (Fig. 2).

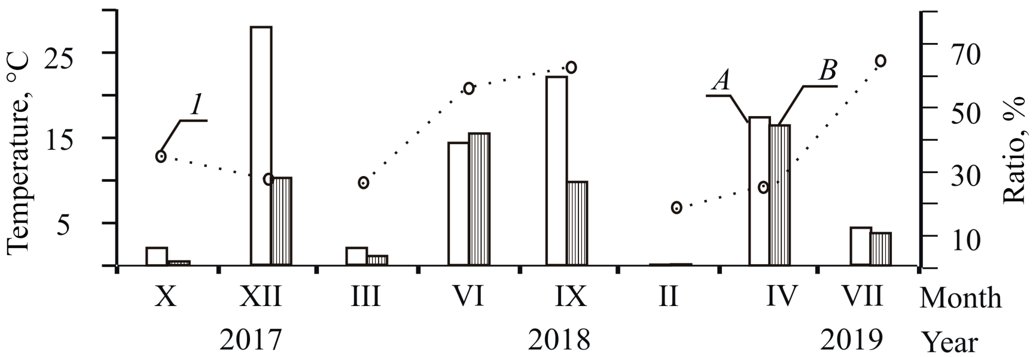

Fig. 2. Seasonal changes in surface water temperature (1) and ratio of meroplankton in zooplankton (% of total zooplankton abundance) in the seaport Kavkaz area in 2017–2019 (A, the seaport; B, the background station)

Meroplankton ratio in zooplankton during the study period varied from 0.003–0.0015 % in February to 74.8 % in December (see Fig. 2).

A significant increase in meroplankton ratio in zooplankton was observed at low temperatures (+6…+10 °C) – during a seasonal decline in holoplankton reproduction. The value was high in December and April when larvae of cirripedians formed the basis of meroplankton pool. In summer and early autumn – with the water warming up to +21…+24.5 °C – abundance of benthic invertebrate larvae in zooplankton naturally increased. In the dynamics of meroplankton abundance, three density peaks were noted (April, June, and September); those were most pronounced in the seaport area in spring (2.9 thousand ind.·m^{-3}) and in the open area in early autumn (2.6 thousand ind.·m^{-3}) (Fig. 3).

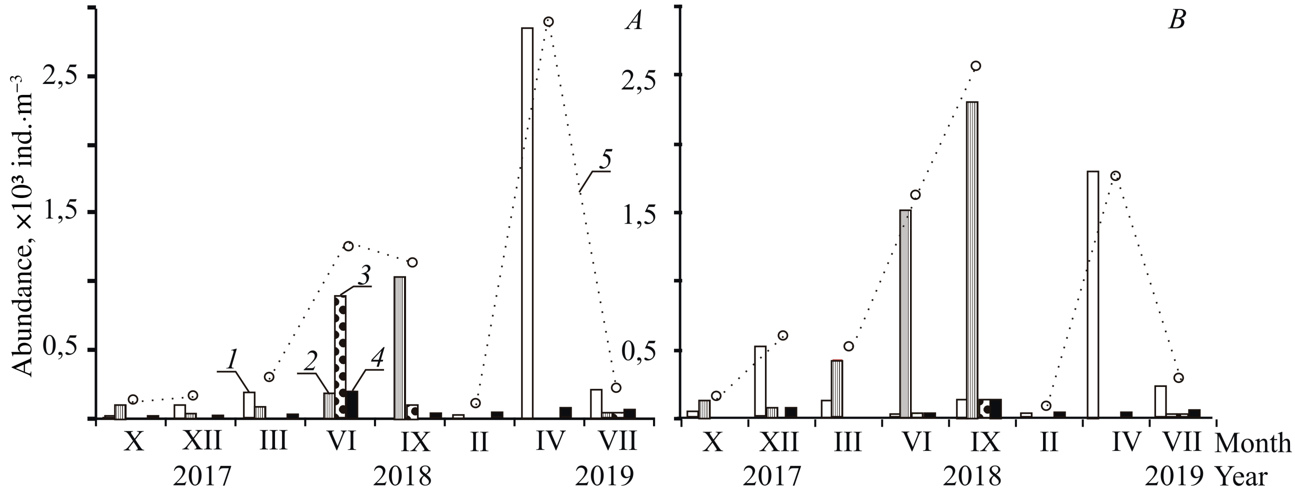

Fig. 3. Seasonal dynamics of meroplankton abundance (thousand ind.·m^{-3}) in the seaport Kavkaz area in 2017–2019: A, the seaport; B, the background station (1, cirripedians; 2, bivalves; 3, gastropods; 4, polychaetes; and 5, total meroplankton)

Phenology of benthic invertebrate larvae. In October–December 2017, at a temperature of +10…+13 °C, meroplankton was poorly represented (2–4 taxa) due to a seasonal decline in the reproduction of benthic invertebrates. In October, meroplankton ratio in zooplankton composition did not exceed 0.5–4.5 %. Everywhere, total abundance of benthic invertebrate larvae was lower than 0.12 thousand ind.·m^{-3}. An autumn generation of benthic invertebrate larvae was represented mainly by those of bivalve *Mytilus galloprovincialis* (93.6 %) and cirripedian *Amphibalanus improvisus* (6.4 %). In December, total meroplankton abundance varied from (0.3 ± 0.07) thousand ind.·m^{-3} in the seaport to 0.61 thousand ind.·m^{-3} in the open area. Meroplankton contribution to total zooplankton abundance increased on average up to 30 and 74.8 %, respectively. In the seaport area, larvae of cirripedian *A. improvisus* prevailed – (0.29 ± 0.06) thousand ind.·m^{-3} (96.2 % of total meroplankton abundance). In the open area, along with them, larvae of bivalve *M. galloprovincialis* were recorded.

By the end of March 2018, the water warmed up to +10 °C, and meroplankton ratio in zooplankton composition increased up to 4–5.6 %. In plankton, larvae of polychaete *Polydora cornuta*, cirripedian *A. improvisus*, and bivalve *M. galloprovincialis* were found. Total meroplankton abundance was of (0.34 ± 0.05) thousand ind.·m^{-3} (the seaport) and 0.57 thousand ind.·m^{-3} (the background station). In June, with a rise in water temperature up to +21 °C, the number of taxa increased up to 23–26; meroplankton abundance varied from (1.4 ± 0.09) thousand ind.·m^{-3} in the seaport area to 1.6 thousand ind.·m^{-3} outside it. Meroplankton ratio in zooplankton composition reached 38.6–44.9 %. In the seaport area, larvae of gastropod *B. reticulatum* were abundant [(0.9 ± 0.05) thousand ind.·m^{-3}]; outside the seaport, larvae of bivalve *Mytilaster lineatus* (0.8 thousand ind.·m^{-3}), *Abra segmentum* (0.33 thousand ind.·m^{-3}), and *Cerastoderma glaucum* (0.3 thousand ind.·m^{-3}) prevailed. Along with larvae of these species, larvae of decapods *Diogenes pugilator*, *Upogebia pusilla*, *Palaemon elegans*, and *Rhithropanopeus harrisii* were registered in small abundance, as well as larvae of polychaetes *Nephtys hombergii*, *Harmothoe imbricata*, *Alitta succinea*, *Hediste diversicolor*, Nereididae gen. sp., *Pygospio elegans*, *Microspio mecznikowianus*, and *P. cornuta*; trochophores *Heteromastus filiformis* and *Capitella capitata*; bivalves *Mya arenaria* and *Moerella* sp.; gastropods *Tritia reticulata*, *Hydrobia acuta*, *Rissoa* sp., and *Chrysallida* sp.; and cirripedian *A. improvisus*. In September, 12 meroplankton taxa were identified.

Meroplankton ratio in zooplankton composition reached 27.4–59.9 %. Meroplankton abundance ranged from (1.2 ± 0.07) thousand ind.·m^{-3} (the seaport) to 2.6 thousand ind.·m^{-3} (the background station). An autumn rise in meroplankton abundance in September can be associated with a ctenophore *Beroe ovata* Bruguière, 1789 presence in plankton (0.001 thousand ind.·m^{-3}) – a species which feeds on a ctenophore *Mnemiopsis leidyi* A. Agassiz, 1865. A decrease in density of a zooplankton feeder *M. leidyi* results in an increase in density of holo- and meroplankton (Ctenophore *Mnemiopsis leidyi*, 2000). In early autumn, the complex of prevailing meroplankton species included mainly larvae of bivalve *M. lineatus*; its density in the open area reached a maximum of 2.3 thousand ind.·m^{-3} (84.8–86 % of total meroplankton abundance). The contribution of gastropod *B. reticulatum* was not more than 7–8.6 %. At that time, larvae of the following species were recorded sporadically: bivalve *Anadara kagoshimensis*; gastropod *Rapana venosa*; decapods *D. pugilator*, *U. pusilla*, and *Alpheus dentipes*; polychaetes *Prionospio cirrifera*, *P. cornuta*, Nereididae gen. sp., and *Nephtys* sp.; and cirripedian *A. improvisus*.

In late February 2019, meroplankton was poorly represented due to low water temperature (+6 °C) and a seasonal decline in breeding of benthic invertebrates. Meroplankton ratio in zooplankton composition was negligible – 0.015–0.03 %. In this period, larvae of cirripedian *A. improvisus* were noted, as well as larvae of cold-loving polychaetes *H. imbricata* and *Marenzelleria neglecta*. Total meroplankton abundance varied from (0.008 ± 0.0007) thousand ind.·m^{-3} in the seaport area to 0.003 thousand ind.·m^{-3} outside it. Abundance of *M. neglecta* – a species new for the area – averaged (0.003 ± 0.0008) thousand ind.·m^{-3} (Selifonova, 2019). In April, with a rise in temperature up to +10.5 °C, meroplankton contribution to total zooplankton abundance increased up to 44–47 %. Total meroplankton abundance ranged from (2.9 ± 0.08) thousand ind.·m^{-3} (the seaport) to 1.8 thousand ind.·m^{-3} (the background station). Three taxa of benthic larvae were identified – *H. imbricata*, *P. cornuta* (Polychaeta), and *A. improvisus* (Cirripedia). At the same time, *A. improvisus* larvae made a significant contribution to a larval pool in April 2019 (99.9–100 % of total zooplankton abundance). In July, during a seasonal maximum of a planktonic predator *M. leidyi*, density of benthic invertebrate larvae was low everywhere [(0.2 ± 0.07) thousand ind.·m^{-3}], and meroplankton contribution to total zooplankton abundance was ≤ 12 %. In meroplankton, benthic invertebrate larvae were found – *A. succinea*, *Nephtys* sp., *P. cornuta* (Polychaeta), *A. improvisus* (Cirripedia), *M. lineatus* (Bivalvia), and *H. acuta* (Gastropoda). In total meroplankton abundance, cirripedian larvae prevailed accounting for 95.2–98.2 %.

DISCUSSION

Meroplankton taxonomic composition and peculiarities of its seasonal cycle registered by us in the seaport Kavkaz area (the northern Kerch Strait) correspond to those previously recorded for the Sea of Azov and the coastal zone of the northeastern Black Sea (Selifonova, 2008, 2014). Differences in structure and dynamics of meroplankton quantitative indicators result from zoobenthos distribution, hydrochemical water regime, direction of prevailing currents in the strait, and other factors (Kazankova & Nemirovsky, 2003 ; Kulikova et al., 2017 ; Lisitskaya, 2017 ; *etc.*). As known, the nature of meroplankton seasonal distribution in the Sea of Azov depends primarily on the pressure of a predatory ctenophore *M. leidyi* feeding on a significant part of meroplankton at a peak of its development (Matishov et al., 2015). Therefore, in dynamics of zooplankton density in the Sea of Azov, there is no summer–autumn peak, while in the Black Sea, such a peak is observed annually (Lisitskaya, 2017 ; Selifonova, 2014). For *M. leidyi*, the only natural enemy in the Black Sea waters is *B. ovata* – not a permanent inhabitant, but a species forming a pseudo-population in late summer and early autumn (Volovik et al., 2008). At this season, an outbreak of *B. ovata* abundance leads to constructive changes in the Black Sea zooplankton community. In the Kerch Strait, with salinity closer to that of the Black Sea, we recorded a similar autumn increase in meroplankton abundance. The lower salinity of the Sea of Azov waters hinders *B. ovata* development, and similar processes in this water area occur in the Kerch pre-strait alone (the southern Sea of Azov) (Ctenophore *Mnemiopsis leidyi*, 2000).

Meroplankton of the Kerch Strait in the seaport Kavkaz area and the Sea of Azov – in contrast to meroplankton of bays of the northeastern shelf and Crimea – is characterized by low taxonomic richness (Lisitskaya, 2017 ; Selifonova, 2008, 2014). However, sufficient reproductive potential of both the Sea of Azov and Black Sea species of benthic invertebrates is concentrated in this area (Golovkina & Nabozhenko, 2012 ; Fashchuk et al., 2012). Mass spawning of benthic invertebrates occurs April to September. In the dynamics of meroplankton abundance in the seaport Kavkaz area, three density peaks were registered (in April, June, and September); those werev most pronounced in the seaport area in spring and in the open area in early autumn (up to 3 thousand ind.·m^{-3}). In June, at water temperature of +21 °C, meroplankton was diverse and constituted a significant ratio of zooplankton. In its structure, mollusc larvae prevailed (85.3–93.7 % of total meroplankton abundance); out of them, the most noticeable ones were larvae of gastropod *B. reticulatum* and bivalves *A. segmentum* and *C. glaucum*. Mass spawning of these bivalve species is usually observed in the Sea of Azov (Selifonova, 2008). In winter, larvae of polychaete *M. neglecta* – a species new for the area – were recorded sporadically in the study area. In the Sea of Azov, at low water temperature (0…+1.2 °C), this species gives an outbreak of abundance – up to a hundred thousand ind. *per* m^3; it is most pronounced in the Taganrog Bay (Selifonova, 2019).

Long-term mean quantitative indicators of meroplankton density in the seaport area differed insignificantly from those at the background station. In the seaport area, larvae of cirripedians, bivalves, and gastropods were abundant; outside the seaport, larvae of cirripedians and bivalves prevailed. Meroplankton ratio in zooplankton composition in the seaport Kavkaz area was on average 1.5 times higher than at the background station. As known, communities of detritus-rich port waters include mainly organisms resistant to high content of organic matter, *inter alia* meroplankton (Selifonova, 2014). In the seaport Kavkaz area, the basis of meroplankton pool was formed by species tolerant to water eutrophication and bottom sediment sulfide contamination (Sorokin & Burkatskii, 2007) – larvae of gastropod *B. reticulatum*, larvae of bivalves *A. segmentum*, *C. glaucum* (in summer), and *M. lineatus* (in early autumn), and larvae of cirripedian *A. improvisus* (in spring).

Conclusion. For the first time, meroplankton state under conditions of pollution in the seaport Kavkaz area (the northern Kerch Strait) was analyzed. As noted, meroplankton density in the polluted area is not inferior to that of the relatively clean area and provides sufficient reproductive potential there. In the seaport area, larvae of cirripedians and molluscs were abundant, while outside the seaport, larvae of cirripedians and bivalves prevailed. The basis of meroplankton pool was formed by species tolerant to water eutrophication and bottom sediment sulfide contamination. Those were larvae of gastropod *B. reticulatum*, larvae of bivalves *A. segmentum*, *C. glaucum* (in summer), and *M. lineatus* (in early autumn), and larvae of cirripedian *A. improvisus* (in spring).

In the seasonal dynamics of meroplankton in the study area, a summer–autumn increase in abundance was revealed which is characteristic for the Black Sea waters. The period of the greatest zoobenthos spawning and larvae release into the pelagial lasted April to October. Three density peaks were registered (April, June, and September), and those were most pronounced in the seaport area in spring and in the open area in early autumn.

The obtained data give an idea of the current state of both pelagic and benthic communities and may be useful for further monitoring in this area.

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ТАКСОНОМИЧЕСКИЙ СОСТАВ И СЕЗОННАЯ ДИНАМИКА МЕРОПЛАНКТОНА В РАЙОНЕ МОРСКОГО ПОРТА КАВКАЗ, КЕРЧЕНСКИЙ ПРОЛИВ

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В северной части Керченского пролива (район морского порта Кавказ) был проведён мониторинг видового состава меропланктона, распределения его обилия и сезонной динамики численности. Материалом для исследования послужили сборы зоопланктона в разные сезоны 2017–2019 гг. в портовом районе и за его пределами. Тотальные ловы зоопланктона производили большой сетью Джеди (диаметр входного отверстия — 37 см, размер ячеи — 120 мкм) на глубинах от 5 до 8 м. Пробы фиксировали 2–4%-ным раствором нейтрального формальдегида и обрабатывали в лабораторных условиях по стандартной методике. Обнаружено 32 таксона меропланктона. Отмечено, что по плотности меропланктон загрязнённого района не уступает меропланктону относительно чистого участка и обеспечивает в них достаточный репродуктивный потенциал. В портовом районе массовыми были личинки усоногих раков и моллюсков, за пределами порта — личинки усоногих раков и двустворчатых моллюсков. Основу пула меропланктона составляли виды, толерантные к эвтрофикации вод и сульфидному заражению донных осадков, — личинки брюхоногих моллюсков *Bittium reticulatum*, личинки двустворчатых моллюсков *Abra segmentum*, *Cerastoderma glaucum* (летом) и *Mytilaster lineatus* (в начале осени), личинки усоногих раков *Amphibalanus improvisus* (весной). В сезонной динамике меропланктона исследуемого района выявлено летне-осеннее увеличение обилия, характерное для черноморских вод. Период наибольшего нереста донных животных и выхода в пелагиаль личинок продолжался с апреля по октябрь. Отмечено три пика плотности (апрель, июнь и сентябрь), которые были наиболее выражены в районе порта весной, а в открытой части — в начале осени.

Ключевые слова: меропланктон, численность, сезонная динамика, Керченский пролив